DS 7: Atomic Layer Deposition

Time: Monday 12:30–13:15 Location: CHE 89

DS 7.1 Mon 12:30 CHE 89

Atomic layer deposition (ALD) for the fabrication of HfO_2- and TiO_2- based resistive switching memories — •Alexander Hardtdegen, Hehe Zhang, and Susanne Hoffmann-Eifert — Peter Grünberg Institute and JARA-Fit, Forschungszentrum Jülich, 52425 Jülich, Germany

One common growth method for ultrathin metal oxide layers used in resistive switching devices is atomic layer deposition. Often used materials for these devices are e.g. HfO_2 and TiO_2, which are generally deposited in the amorphous phase. Nevertheless resistive switching behaves differently even in cells out of the apparently same material, as the switching properties are very sensitive to the amount of oxygen in the functional layers.

In this study, plasma-enhanced ALD HfO_2 is combined with three qualitative different (sub-)stoichiometric TiO_2-layers, comparing either layers which were deposited with liquid injection and bubbler supplied TDMAT or thermal processes with processes based on oxygen plasma as co-reactant. The bilayers were integrated into metal-insulator-metal structures and electrically characterized. The switching behavior gives information about the oxygen amount within the different TiO_2-layers.

DS 7.2 Mon 12:45 CHE 89

Al_2O_3 ALD on pristine graphene — •Marcel Junige[1], Julia Kitzmann[2], Marion Geidel[1], Grzegorz Lupina[2], Matthias Albert[1], Christian Wenger[2], and Johann W. Bartha[1] — [1]Technische Universität Dresden — [2]IHP GmbH, Frankfurt (Oder)

Coating monolayer graphene (here: CVD-G) with ultra-thin (<10 nm), continuous (pinhole-free), smooth, and electrically well-insulating films is prerequisite for graphene-based applications in electronics, sensors, etc., but has yet been very challenging due to graphene's lack of dangling bonds. Thus, the nucleation of a dielectric's Atomic Layer Deposition (ALD) on CVD-G has commonly been inhibited and the corresponding Volmer-Weber island growth mode has produced sporadic, rough, and electrically leaky deposits, preferentially decorating defects.

Apart from a previous improvement[1] by pre-treating CVD-G with NF_3, we studied here a lower Al_2O_3 ALD set-point temperature of 200 °C compared to 400 °C on pristine CVD-G. The reduced deposition temperature indeed supported a faster and more dense Al_2O_3 ALD nucleation upon the plane CVD-G surface. The ALD growth initiation, the CVD-G integrity, and the coating morphology were investigated by a unique metrology combination of *in-situ* real-time Spectroscopic Ellipsometry, *in-vacuo* X-Ray Photoelectron Spectroscopy, and Atomic Force Microscopy, respectively.

[1] Junige, M. *et al.* in *Proc. of SPIE Vol. 9519*, p. 951915 – DOI:10.1117/12.2181242.

DS 7.3 Mon 13:00 CHE 89

A hybrid molecular beam epitaxy based growth method for large-area synthesis of stacked hexagonal boron nitride/graphene heterostructures — •Siamak Nakhaie[1], Joseph M. Wofford[1], Thilo Krause[1], Xianjie Liu[2], Manfred Ramsteiner[1], Michael Hanke[1], Henning Riechert[1], and J. Marcelo J. Lopes[1] — [1]Paul-Drude-Institut für Festkörperelektronik, Hausvogteiplatz 5-7, 10117 Berlin, Germany — [2]Department of Physics, Chemistry and Biology, Linköping University, SE-58183 Linköping, Sweden

Devices based on the graphene/hexagonal boron nitride (h-BN) materials system offer a host of potential advantages, including high speed, extremely low power consumption, and various novel functionalities. As a result, the large-area synthesis of this material has been extensively researched over the past few years using various crystal growth techniques. In this contribution, we introduce a method for the production of h-BN/graphene heterostructures which allows both materials to form on the surface of the Ni substrate. We exploit the finite solubility of C in Ni by first saturating the metal film, then depositing a few-layer thick h-BN film from elemental B and N on the exposed Ni surface, and finally ramping the sample temperature down to controllably precipitate the C and form graphene at the interface between the h-BN and Ni. The resulting heterostructures are studied using various characterization techniques, such as UV and visible Raman spectroscopy, x-ray photoelectron spectroscopy and synchrotron-based grazing incidence spectroscopy to learn about their structural properties and quality.